SRI MUTHUKUMARAN INSTITUTE OF TECHNOLOGY

(Approved by AICTE, Accredited by NBA and Affiliated to Anna University, Chennai)

Chikkarayapuram (Near Mangadu), Chennai- 600 069.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

EC8701 – ANTENNA AND MICROWAVE ENGINEERING
(REGULATION – 2017)

YEAR: IV **SEM: VII**

UNITII :- RADIATIONMECHANISMSANDDESIGNASPECTS

PARTA

1.Calculatethebeamwidthbetweenfirstnullsofa2.5mparaboloidreflectorusedat 6GHz.(N/D’20)

$$\lambda = \frac{300}{f(MHz)}$$

$$\frac{300}{6\times10^{3}} = 50\times10^{-3}\ meters$$

HenceBWFN= $140\frac{\lambda}{D}$ degrees= $140\times\frac{50\times10^{-3}}{2.5}$

$=140\times20\times10^{-3}$

$=2800\times10^{-3}=2.80$

$$G_P = 6\left(\frac{D}{\lambda}\right)^2 = 6\left(\frac{2.5}{50\times10^{-3}}\right)^2 = 15000$$

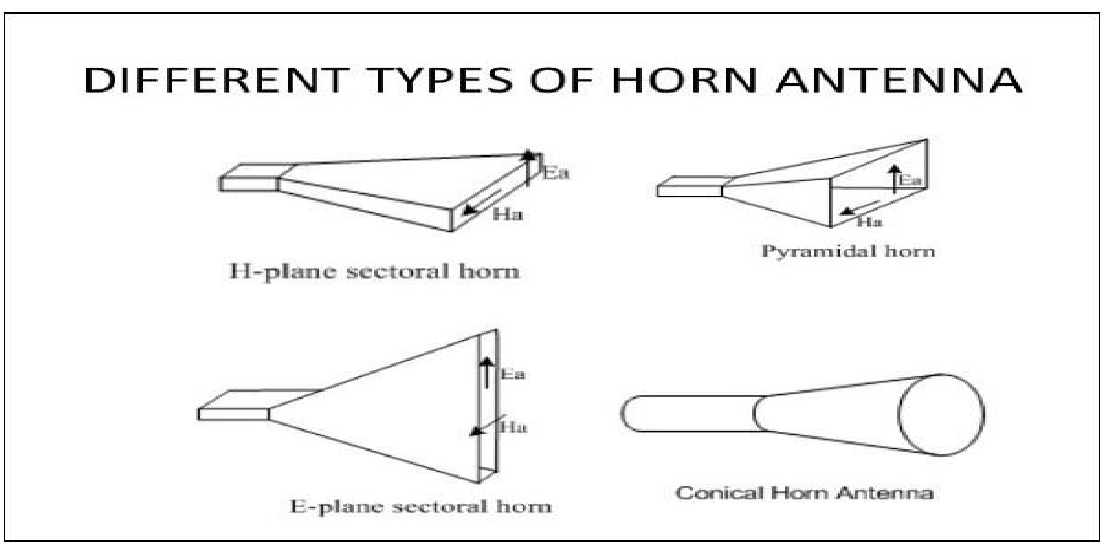
$$GP = 10\log_{10}15000 = 10\times4.1761 = 41.761db$$

Whatisapertureblockage?Giveoneexample.(N/D‘20)

Theeffectofantennapartslyingthepathofraysarrivingatordepartingfromaradiatingelements orthe aperture anantenna.

Example:Thefeeds,Subreflectors.

Drawvarioustypesofhornantenna.(N/D’19)



4. **State Babinet’sprinciple.(N/D’19)(OR) State Babinet’s principle applied to the slotantenna.(N/D’18) (N/D’17) (OR) On what principle slot antenna works? Explain theprinciple.(M/J’16)**

   When the field behind a screen with an operating is added to the filed on a complementarystructure, thesum is equaltothefiled when thereis noscreen

5. **Writeanytwodifferencebetweenslotantennaanditscomplementarydipole antenna.(A/M’19)**
   - Theelectricand magneticfieldsareinterchanged
   - The direction of the lines of electric and magnetic force abruptly reverse from oneside of the metal sheet to the other. In the case of the dipole, the electric lines havethesamegeneraldirectionwhilethemagneticlinesformcontinuousclosedloops.

6. **Listthedifferentmethodsoffeedingmicrostripantenna.(A/M’19)**
   1. **Contacting feeding**: In this method the R.f power is fed directly to the radiating patchwhichusesaconnectingelement suchasmicrostriporco-axialline.
   2. **Non contacting feeding:** In this method ,electro magnetic coupling is done to transferthe power from feed line to the radiating patch. The most commonlyused non-contacting feed method are aperture coupling and proximitycoupling.

7. **Whatarethesecondaryantenna?Givetwoexamples.(N/D’17)**

   Antennathatarenotradiatorsbythemselvesarecalledsecondaryantenna.Example:Cassegrain,Hyperbolic antenna

8. **Definepitchangleofahelicalantenna.(A/M’19)**

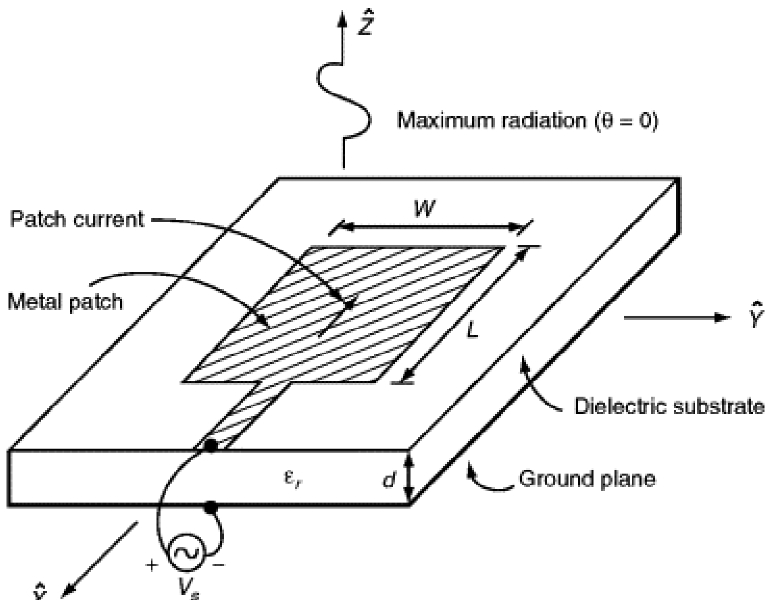
   Pitch angle (α) is the angle between a line tangent to the helix wire and the plane normal tothehelixaxis.

   $$\tan\alpha = \frac{S}{C} = \frac{S}{\pi D} = \tan^{-1}\frac{S}{\pi D}$$

9. **StateHuygen’sprinciple.(A/M’18)**

   Huygen;s principle states that ‘ each point on a primary wave front can be considered to beanewsourceofasecondarysphericalwaveandthatasecondarywavefrontcanbeconstructed asthe envelope ofthesewaves.

10. **Drawthediagramrepresentingrectangularmicrostripantenna.Listthesubstrates usedformicrostripsantenna.(N/D’18)**
    - Dielectricsubstrateused



11. Writeanytwodifferencesbetweenslotantennaanditscomplementarydipole antenna.(A/M'18)

- Polarizationaredifferentie.Theelectricfieldsassociatedwiththeslotantennaareidenti calwiththemagnetic field ofthecomplementarydipoleantenna.
- Theelectricfieldbeverticallypolarizedfortheslotandhorizontallypolarizedforthedip ole
- Radiationfromthebacksideoftheconductingplaneoftheslotantennahasoppositepola rityfromthat of complementaryantenna

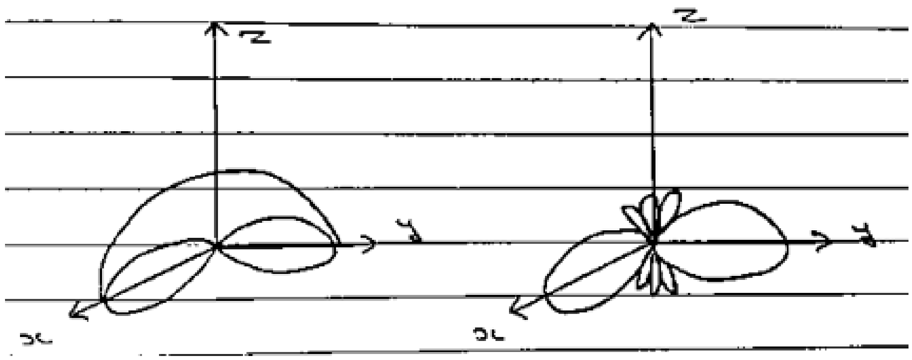
12. Whatarethedifferenttypesofhornantenna?(A/M'17)

- Sectoralhorn
- Pyramidalhorn
- Conicalhorn
- Biconicalhornantenna

13. Mentionthefouradvantagesofmicrostripantenna.(A/M'17)

- Themicrostripantennaare thelowprofileantennas.Theyareofsmallersize,lightweightantennaswhich occupyvery lessvolume.
- Lowfabricationcost,hencecanbemanufacturedinlargerquantities.
- ItcanbeeasilyintegratedwithMICs
- Itcapableofdualandtriple frequencyoperations

14. **Drawtheradiationpatternforisotropic,directionalandomnidirectional antenna.(A/M'17)**



15. **For a 20 turn helical antenna operating at 3 ghz with circumference C=10cm and thespacingbetweentheturns0.3 λ.calculatethedirectivityandhalfpowerbeamwidth. (N/D'17)**

Given

$$S=0.3\lambda, f=3GHz, C=10cm\ N=20$$

$$\lambda=\frac{c}{f}=\frac{3\times 10^8}{3\times 10^9}=0.1m$$

Directivity,

$$D=\frac{15NSC^2}{\lambda^3}$$

$$D=\frac{15\times 20\times .3n\times(10\times 10^{-2})2}{\lambda^3}$$

$$=\frac{15\times 20\times .3\times(10\times 10^{-2})2}{(.1)^2}$$

$$D=90$$

Halfpowerbeamwidth, $HPBW=\frac{52}{C}\sqrt{\frac{\lambda^3}{NS}}$ degree

$$HPBW=\frac{52}{10\times 10^{-2}}\sqrt{\frac{(0.1)^3}{20\times 0.3\times 0.1}}$$

$$HPBW=21.23$$

16. **Whatisafrequencyindependentantenna.(A/M’18)(N/D’17)**

    A frequency independent antenna is physically fixed size and operate on can instantaneousbasic over a wide bandwidth with relatively constant impedance, pattern ,polarization andgain.

17. **StateRumseyprincipleonfrequencyindependence.orstateRumseyprinciple (A/M’17)(M/J’16)(N/D’16)**

    Rumsey's principle suggests that the impedance and pattern properties of an antenna willbefrequency independent ifthe antenna shapeisspecifiedonly in termsof angles.Tosatisfythe equal-angle requirement, the antenna configuration needs to be infiniteinprinciple, butisusuallytruncatedinsize inpractice.

18. **Find the terminal resistance of complementary slot for a cylindrical dipole withlength to diameter ratio of 28 and length of 0.925λ having terminal impedance of $(710+j0)$ ohms.**

    Since $Z_s = \frac{35,476}{710+j0} = \frac{35,476}{710} \simeq 49.966 \simeq 50$ ohms

    $Z_s \approx 50 + j0$ ohms

    Since $L = 0.925\lambda$ and $\frac{L}{D} = 28$

    $D = \frac{L}{28} = \frac{0.925\lambda}{28} = 0.033\lambda$

    $\omega = 2D = 2\times 0.033\lambda = 0.066\lambda$

19. **Determinethegainofacassegrainantennaofdiameter70matafrequency8.45GHz.Assumeasapertureefficiency of80%.**

    $f = 8.45$ GHz, D=70 m, K=0.8

$$\text{Gain} = \frac{4\pi A_O}{\lambda^2} = \frac{4\pi K A}{\lambda^2} = \frac{4\pi K}{\lambda^2}\left(\frac{\pi D^2}{4}\right)$$

$$\lambda = \frac{c}{f} = \frac{3\times 10^8}{8.45\times 10^9} = 0.0355\text{m}$$

$$\text{Gain} = \pi^2 K \left(\frac{D}{\lambda}\right)^2 = (3.14)^2 \times 0.8 \times \left(\frac{70}{0.0355}\right)^2$$

$$\text{Jain} = 30.66\times 10^6$$

20. **Estimatethediameterofaparaboloidalreflectorrequiredtoproduceabeamof5^0 widthat 1.2GHz. How would youmakethisreflector?**

    BWFN $= 5^\circ$

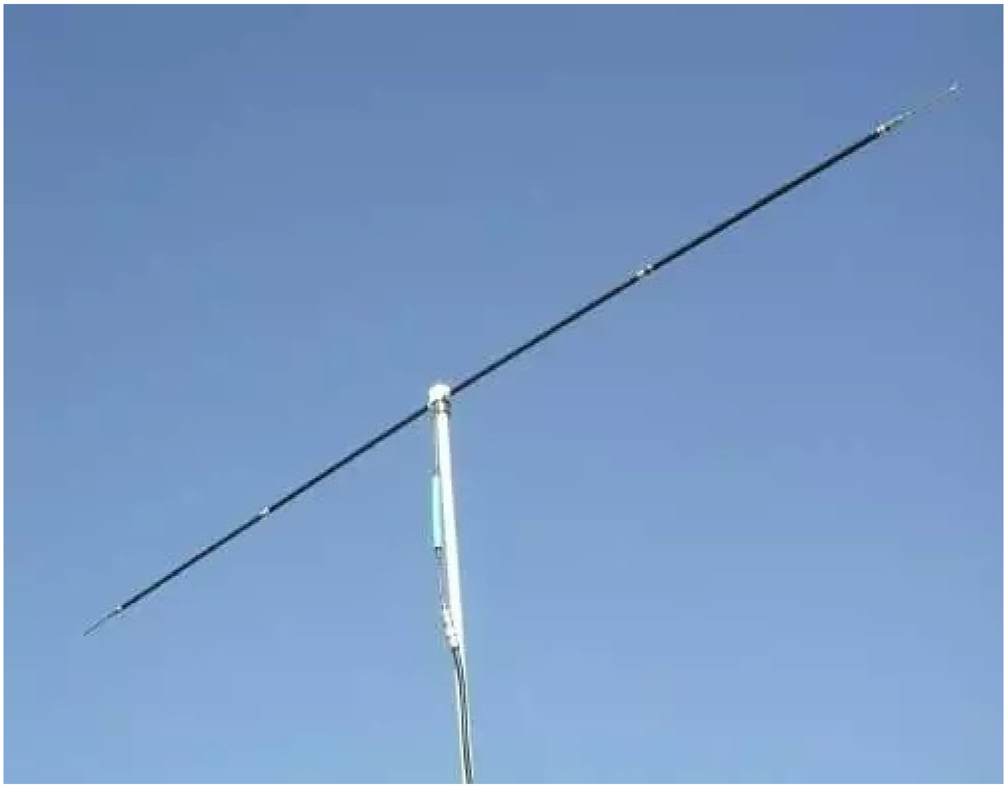
    $f = 1.2$ GHz; Then $\lambda = \frac{3\times 10^8}{1.2\times 10^9} = \frac{3}{12} = \frac{1}{4}$

$BWFN = 5^\circ = \frac{140\lambda}{D}$; $D = \frac{140\times 1}{4\times 5} = 7$ metres

PART-B

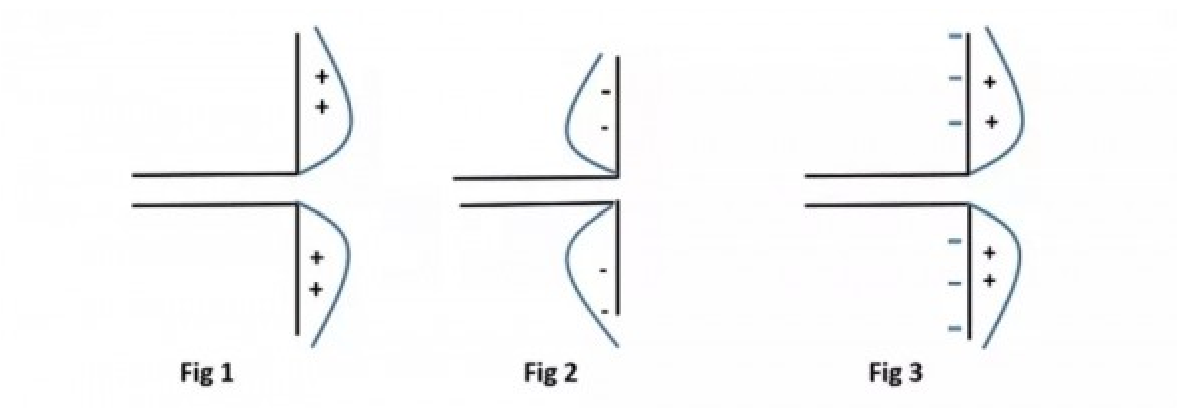
1. Explain in construction and working of Hertz antenna.

The dipole antenna is a widely popular antenna that is used mostly for the reception. The dipole antenna is cut and bent for effective radiation. The length of the total wire, which is being used as a dipole, equals half of the wavelength (i.e., $l = \lambda/2$). Such an antenna is called as a half-wave dipole antenna, also known as Hertz antenna. This antenna which is mostly used in radio receivers operates is around 3KHz to 300GHz.



Construction & Working of Half-Wave Dipole

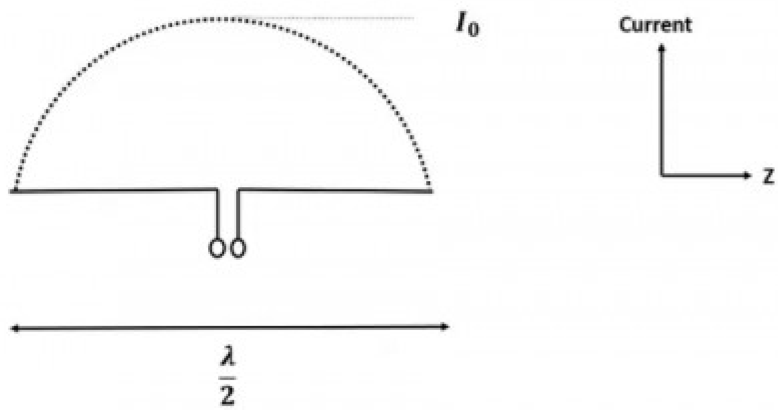
The edge of the dipole has maximum voltage. This voltage is alternating (AC) in nature. At the positive peak of the voltage, the electrons tend to move in one direction and at the negative peak, the electrons move in the other direction.



The figures given above show the working of a half-wave dipole.

- Fig 1 shows the dipole when the charges induced are in the positive half cycle. Now, the electrons tend to move towards the charge.
- Fig 2 shows the dipole with negative charges induced. The electrons here tend to move away from the dipole.
- Fig 3 shows the dipole with next positive half cycle. Hence, the electrons again move towards the charge.

The cumulative effect of this produces a varying field effect which gets radiated in the same pattern produced on it. Hence, the output would be effective radiation following the cycles of the output voltage pattern. Thus, a half-wave dipole radiates effectively.

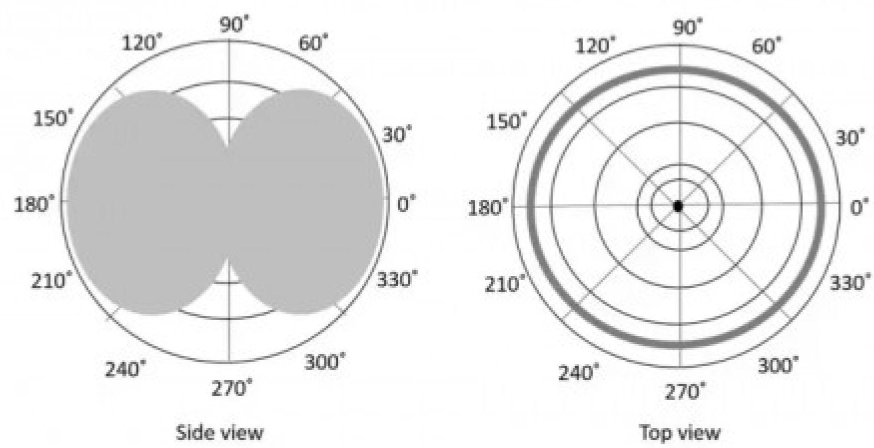


The above figure shows the current distribution of half wave dipole. The directivity of half wave dipole is 2.15dBi, which is reasonably good. Where 'i' represents the isotropic radiation.

Radiation Pattern

The radiation pattern of this half-wave dipole is Omni-directional in the H-plane. It is desirable for many applications such as mobile communications, radio receivers etc.

The figure below indicates the radiation pattern of a half wave dipole in both H-plane and V-plane.



The radius of the dipole does not affect its input impedance in this half wave dipole because the length of this dipole is a half wave and it is the first resonant length. An antenna works effectively at its resonant frequency, which occurs at its resonant length.

Advantages

- Input impedance is not sensitive
- Matches well with transmission line impedance
- Has reasonable length
- Length of the antenna matches with size and directivity

Disadvantages

- Not much effective due to the single element
- It can work better only with a combination

Applications

- Used in radio receivers
- Used in television receivers
- When employed with others, used for wide variety of applications

2.

2)Explain the working principle of Horn antenna.

Horn Antenna

- Antenna and Wave propogation / By Roshni Y / 1 Comment
- **Definition**: Horn antenna is a type of antenna which is constructed when the end of the antenna is flared out or tapered in the shape of a horn. Horn antenna operates in **microwave frequency**.
- These operate in ultra-high and super-high frequencies ranging between **300 MHz to 30 GHz**.
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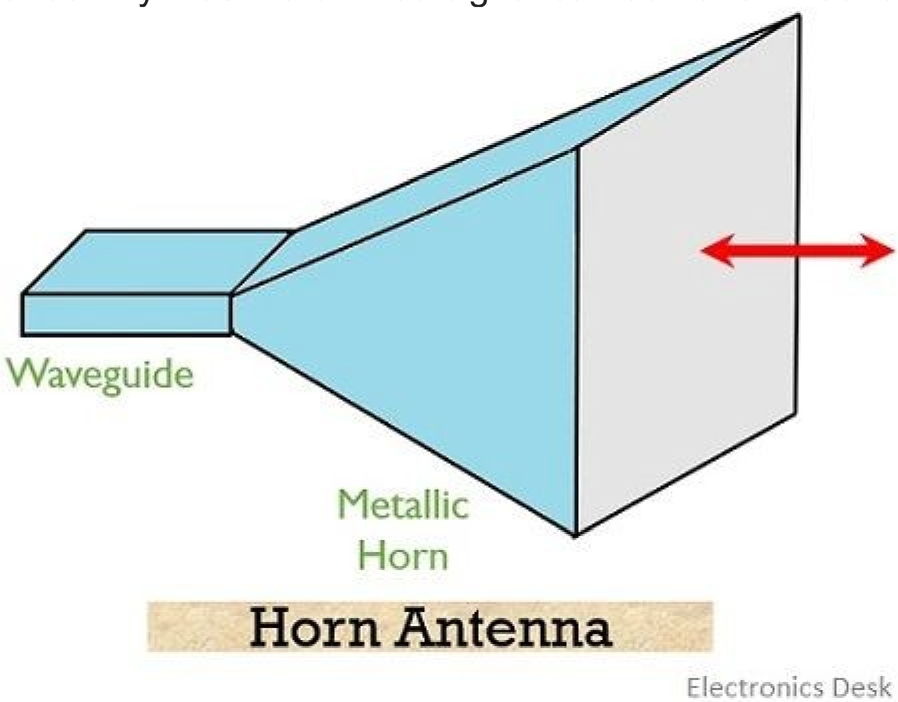
- t is generally considered as a waveguide whose one of the ends is widened out in the shape of the horn. Due to the flared-out structure of the antenna, there is greater directivity thus the emitted signal can be transmitted to longer distances.



Need of Horn Antenna

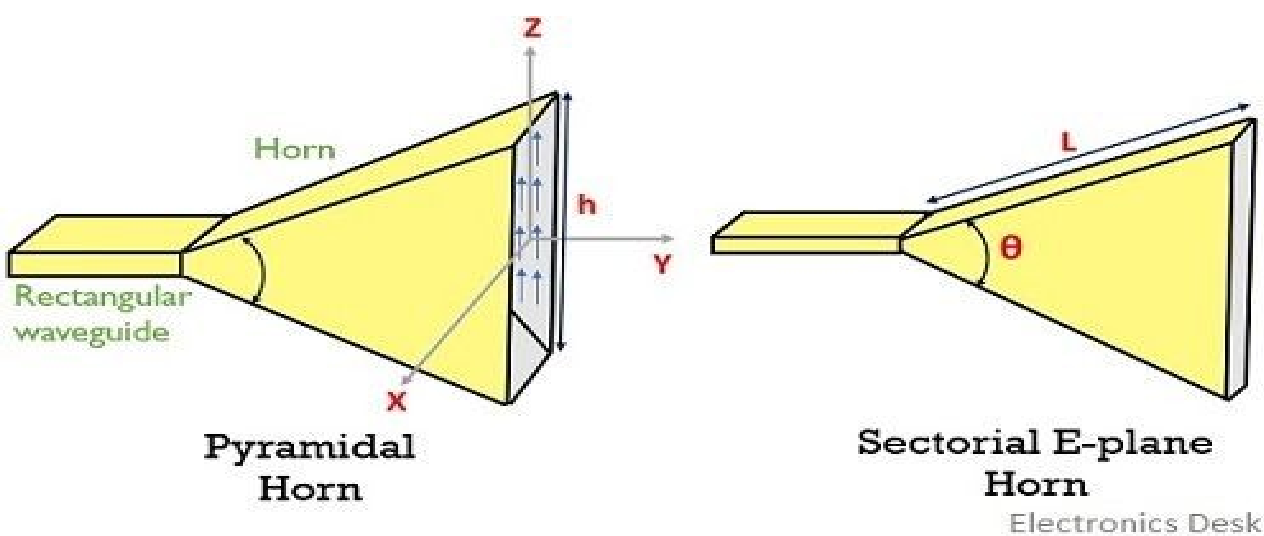
We know that the open end of the waveguide radiates energy, but only a fraction of incident energy is radiated by the waveguide and rest is reflected back by that open end. This is so because due to the open end, there exist poor impedance matching between the waveguide and space.

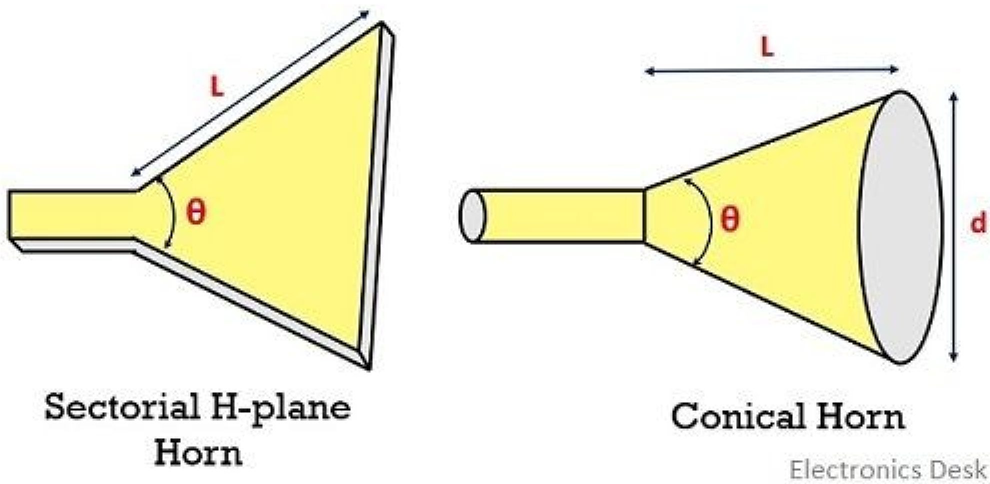
By terminating the waveguide with a horn-like structure, the discontinuity existing between the waveguide and space, having **impedance 377 ohms** is eliminated.

This offers the incident energy to be radiated in forward direction thereby reducing the diffraction at the edges. Hence the directivity of the transmitting antenna is improved and have higher antenna gain there must be a large antenna aperture. And for a given aperture size, high gain is achieved when the tapering is significantly long. Generally, the gain of horn antenna is around **20 dB**. with better gain.

Types of Horn Antenna

- **Pyramidal horn**: A type of horn antenna which is formed by flaring both the walls of the waveguide is known as pyramidal horn antenna. In pyramidal horn antenna generally, a rectangular waveguide is used and the flaring is done in the direction of both electric and magnetic field vectors. Here the flared structure of the waveguide resembles like a pyramid thus is named so.





- **Sectoral horn**: In this type of horn antenna flaring is performed only along one of the walls of the waveguide. However, these are further classified as:

1. **E-plane**: When one of the walls of the waveguide is flared along the direction of electric field vector is known as E-plane sectoral horn antenna.
2. **H-plane**: When the wall of the waveguide is flared along the direction of the magnetic field vector then we call it H-plane sectoral horn antenna.

- **Conical horn**: The formation of a conical horn antenna is a result of flaring a circular waveguide. A circular horn antenna can be either conical or biconical in nature.
- **Exponential horn**: Exponential horn antenna has a curved side and sometimes referred as scalar horn antenna. It is called the exponential horn antenna because the separating distance between the sides rises exponentially as a function of length. These antennas offer constant impedance up to a large frequency thus there are less chances of internal reflections.

Working

Till now we have discussed that a horn antenna is a modified waveguide that is used for transmission of the signal.

We know that one end of the waveguide is excited then the field is generated. Generally, the fields in the waveguide as well as in free space propagate in a similar way. However, in case of propagation through the waveguide, the propagating field is constrained by the walls of the waveguide thereby the field fails to spread spherically while this is not the case with free-space propagation.

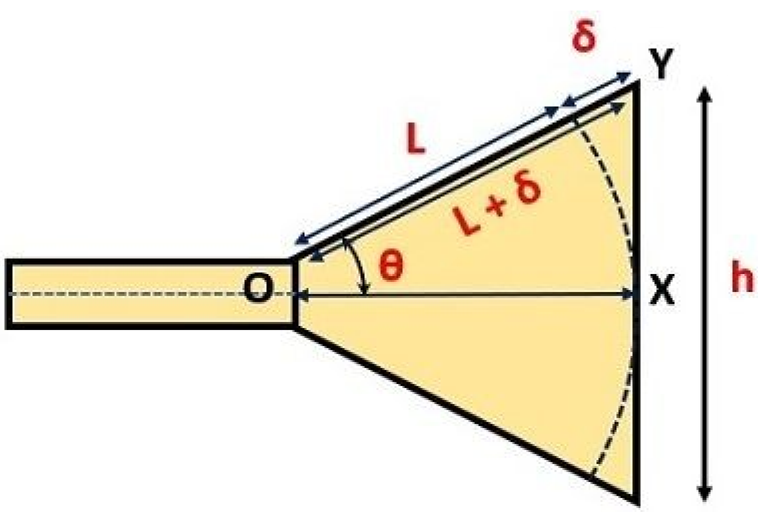
When the traversing field reaches the end of the waveguide then also it propagates in the same manner, however, due to Huygen's principle now the waves begin to spread laterally. Thus, at the end of the structure, **spherical wavefronts** are achieved. Basically, the region is said to be the transition region, where the guided propagation changes to free space propagation.

And as we know that the free space impedance is different from the impedance of the waveguide thus flaring of the waveguide is done to reduce reflections.

The flaring not only offers **impedance matching** but also results in **higher directivity** and **narrow beamwidth** thus we get the desired radiation pattern.

Design equation of Horn Antenna

Suppose we have an E-plane sectoral horn with a source that radiates cylindrical radiations as shown below:



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he electromagnetic horn gives rise to uniform phase front having a greater aperture in comparison to the waveguide. Thereby giving rise to higher directivity.

The uniform wavefronts the propagates in outward direction are cylindrical.

It is noteworthy here that as the wave propagates in a different direction from apex to aperture, thus there exist a difference in phase at the origin and the aperture.

Consider the **path difference** to be δ.

From the geometry of the above figure $\cos\theta = \frac{L}{L+\delta}$

$$\tan\theta = \frac{h/2}{L}$$

and $$\tan\theta = \frac{h}{2L}$$

Therefore, $$\theta = \tan^{-1}\left(\frac{h}{2L}\right) = \cos^{-1}\left(\frac{L}{L+\delta}\right) \quad \text{———} \; 1$$

Considering right angle triangle OYX, and applying Pythagoras theorem,

$$(L+\delta)^2 = L^2 + \left(\frac{h}{2}\right)^2$$

On simplifying $$L^2 + 2L\,\delta + \delta^2 = L^2 + \frac{h^2}{4}$$

Since δ is small thus δ^2 can be neglected.

$$2L\,\delta = \frac{h^2}{4}$$

Hence $$L = \frac{h^2}{8\delta} \quad \text{———} \; 2$$

Therefore equation 1 and 2 are the design equations of the horn antenna.

Advantages

1. These antennas offer easy construction as can be easily configured with a waveguide.
2. The absence of a resonance element in the structure allows it to operate over a wide bandwidth.
3. It provides good impedance matching.
4. Horn antenna is highly directional in nature thereby providing higher directivity.
5. It offers less reflections.

Disadvantages

1. The directivity of the antenna is dependent on the flare angle.
2. The dimensions of the flare must be sufficiently large and this sometimes makes the antenna bulky.

Applications

Microwave frequency operations that require moderate gain, use horn antenna. As we have already discussed that for higher gain the dimensions of the horn must be larger. Thus, it is preferred for **moderate gain operations**.
When we talk about high power gain operations then such applications use lens or parabolic antenna rather than horn antenna.

We know that parabolic reflectors require feeding element to excite them. Thus, the higher directivity offered by the horn antenna allows it to illuminate the reflector. Along with this, these antennas are also used in speed enforcement cameras, so as to avoid reflections that obstruct the desired response.

3) **Explain the principle of Reflector Antenna**.

Antennas that are designed to reflect the incident electromagnetic waves originating from a separate source are known as reflector antennas. It is designed to operate at high microwave frequency.
These antennas belong to the category that offers high directionality while radiating.

ntroduction

Reflector antennas hold great importance when we deal with signals operating in microwave frequency ranges. Initially, it is in use since the time electromagnetic wave propagation came into existence.

Hertz proposed the idea of electromagnetic wave propagation in the year 1888.

However, these antennas gained their major presence in radar systems at the time of World War II.

Operating Principle of Reflector Antennas

We are already aware of the fact that this operates at a high range of microwave frequencies. Also, at this frequency, the electromagnetic wave behaves as a light wave. Hence, it gets reflected when strikes a polished surface.

***This is the principle of operation of a reflector antenna*.**
However, a crucial point over here is that a reflector antenna is a combination of feed element and a reflecting surface.

This means in case of reflector antenna a reflecting surface along with an antenna element is required in order to provide excitation to the reflecting element. This means that it is composed of an active and a passive element.

The antenna that is used to provide excitation is known as the active element. While the one that re-radiates the energy emitted by the active element is the passive element which is nothing but the reflecting surface.
So, simply we can infer that the feed is the active element while the reflector is the passive element.

Generally, dipole, horn or slot antennas are used as the active elements for providing excitation to the reflector antenna. Sometimes the active element is also known as the primary antenna whereas the passive element is called the secondary antenna.

- **Reflector antenna plays a very crucial role in radio wave propagation as it modifies the radiation pattern of the radiating elements.**

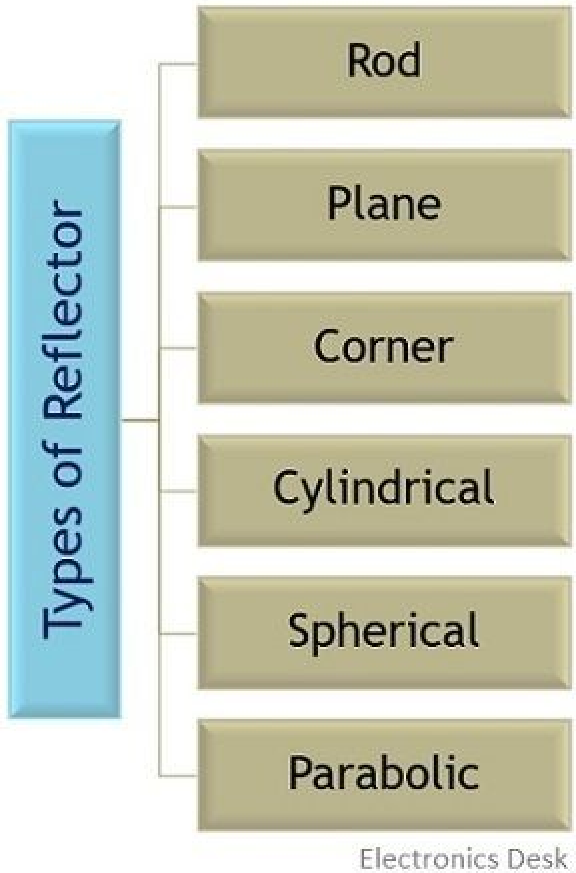
It operates in a way that energy from the feed is directed towards the reflecting surface placed at an appropriate position. The reflector on gaining the energy further guides it in a particular direction.

The radiation pattern of the feed is referred as a primary pattern but that originating from the reflector is referred as a secondary pattern.
It is to be noted here that high gain antennas operating at microwave frequencies possess such a small physical size that reflector of any suitable shape provides the desired directivity.

Despite offering multiple geometrical configurations, there are some popular shapes in which the reflecting surface of the antenna is formed. And on this basis, the reflector antennas are further classified.

Types of Reflectors

Depending on the geometrical shape possessed by the reflecting surface, the reflector antennas are classified into the following categories:



- **Rod Reflector: As the name indicates this type of reflector possesses the shape of a rod. A rod type of reflector is the one which is majorly used in [Yagi-Uda antenna](). The reflector is located at a certain distance behind the driven element in that antenna arrangement and has a length generally more than the length of the driven element i.e., half-wave dipole.**

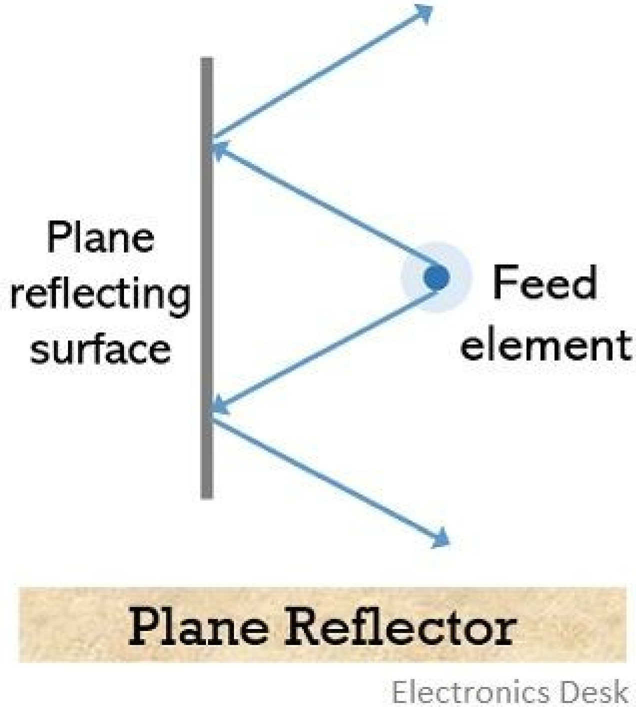
Here the reflector offers inductive reactance so guides the field radiated in the backward direction towards the driven element to reduce the losses due to back-reflected wave. Hence, helps to improve the gain.

It does not serve as an active member of the structure but is a parasitic element.

However, it causes variation in the impedance of the driven element. These types of reflectors exhibit frequency sensitive characteristics.

- **Plane Reflector: It is also referred as flat sheet reflector and is regarded as one of the simplest reflectors that direct the electromagnetic wave in the appropriate direction.**

It is nothing but a plane metallic sheet that is located at a certain distance from the feed. For the incoming radio waves, it acts as a plane mirror and allows them

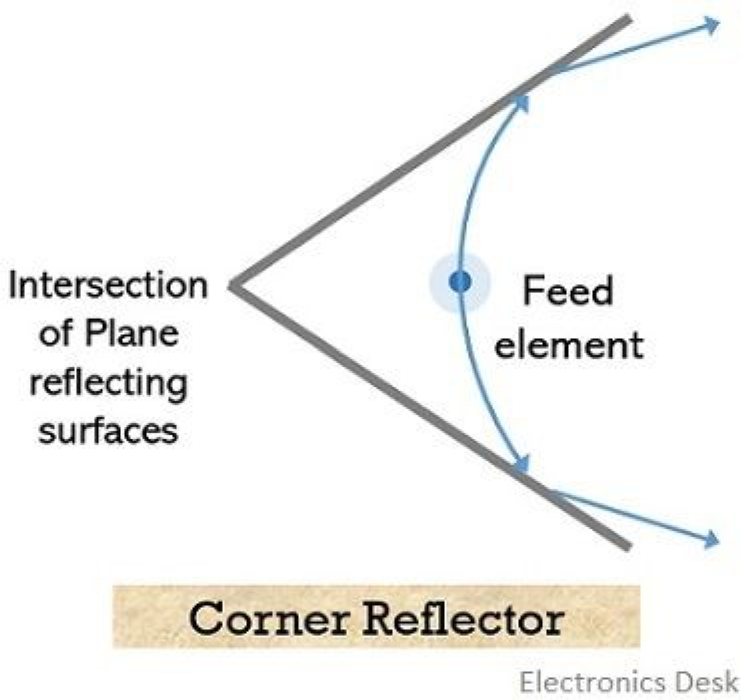


to undergo reflection through it.

It is to be noted that a plane reflector possesses difficulty in collimating the overall energy in the forward direction.

Thus, to handle the impedance, pattern characteristics, gain and directivity of the system, the polarization of the active element along with its position in reference to the reflecting surface is used.

- Corner Reflector: It is regarded as a modified version of the plane reflector so as to guide most of the radiation in the forward direction. Basically, the shape of a plane reflector is changed by joining two flat sheets in order to form a corner. There can also be three mutually perpendicular conducting plane surfaces.



These are basically used to enhance the directing ability of electromagnetic energy in the forward direction so as to reduce the percentage of the back-reflected wave.

- **Cylindrical Reflector: This reflector is designed from a cylindrical structure thus is named so. It is another classification of structure in which a reflector is designed. Thus is nothing but a part of the cylindrical structure. Generally, cylinders are present in parabolic shapes however, other shapes are also present that can be used in its construction.**
- **Spherical Reflector: Like a cylindrical reflector, a spherical reflector is the one designed from a spherical surface. This means these reflectors are part of spherical surfaces and are used for collimating the energy from the active elements towards the forward direction.**
- **Parabolic Reflector: The type of reflector designed in the structure of a paraboloid employing the properties of a parabola is known as a parabolic reflector. The active element is present focusing the main axis, this leads to reflecting the radiated wave in the direction parallel to the main axis.**

This gives rise to a small percentage of minor lobes hence the directivity is improved.

In this reflector, the generally pyramidal or conical horn antenna is used as the feed element.

Applications of Reflector Antennas

These antennas are a major part of communication and radar systems. From point to point communication, TV signal broadcasting to satellite communication these antennas are widely used. Along with these, the other applications of reflector antennas involve weather radar and radio astronomy as well as in spacecraft systems.

4)Explain the working principle of log periodic antenna.

The Yagi-Uda antenna is mostly used for domestic purpose. However, for commercial purpose and to tune over a range of frequencies, we need to have another antenna known as the **Log-periodic antenna**. A Log-periodic antenna is that whose impedance is a logarithamically periodic function of frequency.

Frequency range

The frequency range, in which the log-periodic antennas operate is around **30 MHz to 3GHz** which belong to the **VHF** and **UHF** bands.

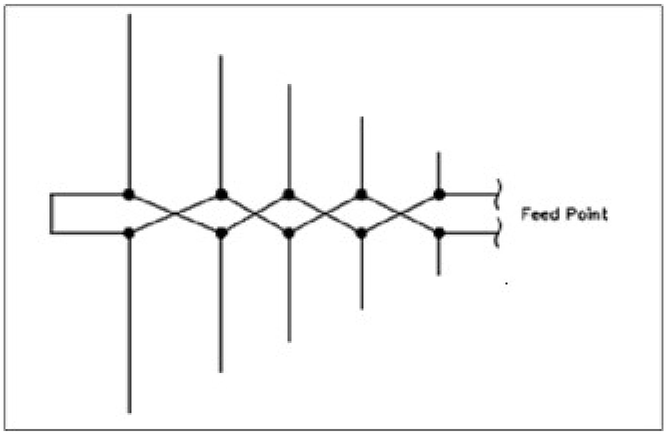
Construction & Working of Log-periodic Antenna

The construction and operation of a log-periodic antenna is similar to that of a Yagi-Uda antenna. The main advantage of this antenna is that it exhibits constant characteristics over a desired frequency range of operation. It has the same radiation resistance and therefore the same SWR. The gain and front-to-back ratio are also the same

The image shows a log-periodic antenna.

With the change in operation frequency, the active region shifts among the elements and hence all the elements will not be active only on a single frequency. This is its **special characteristic**.

There are several type of log-periodic antennas such as the planar, trapezoidal, zig-zag, V-type, slot and the dipole. The mostly used one is log-periodic dipole array, in short, LPDA.



he diagram of log-periodic array is given above.

The physical structure and electrical characteristics, when observed, are repetitive in nature. The array consists of dipoles of different lengths and spacing, which are fed from a two-wire transmission line. This line is transposed between each adjacent pair of dipoles.

The dipole lengths and seperations are related by the formula −

$$R_1 R_2 = R_2 R_3 = R_3 R_4 = T = l_1 l_2 = l_2 l_3 = l_3 l_4$$ �1�2=�2�3=�3�4=�=�1�2=�2�3=�3�4

Where

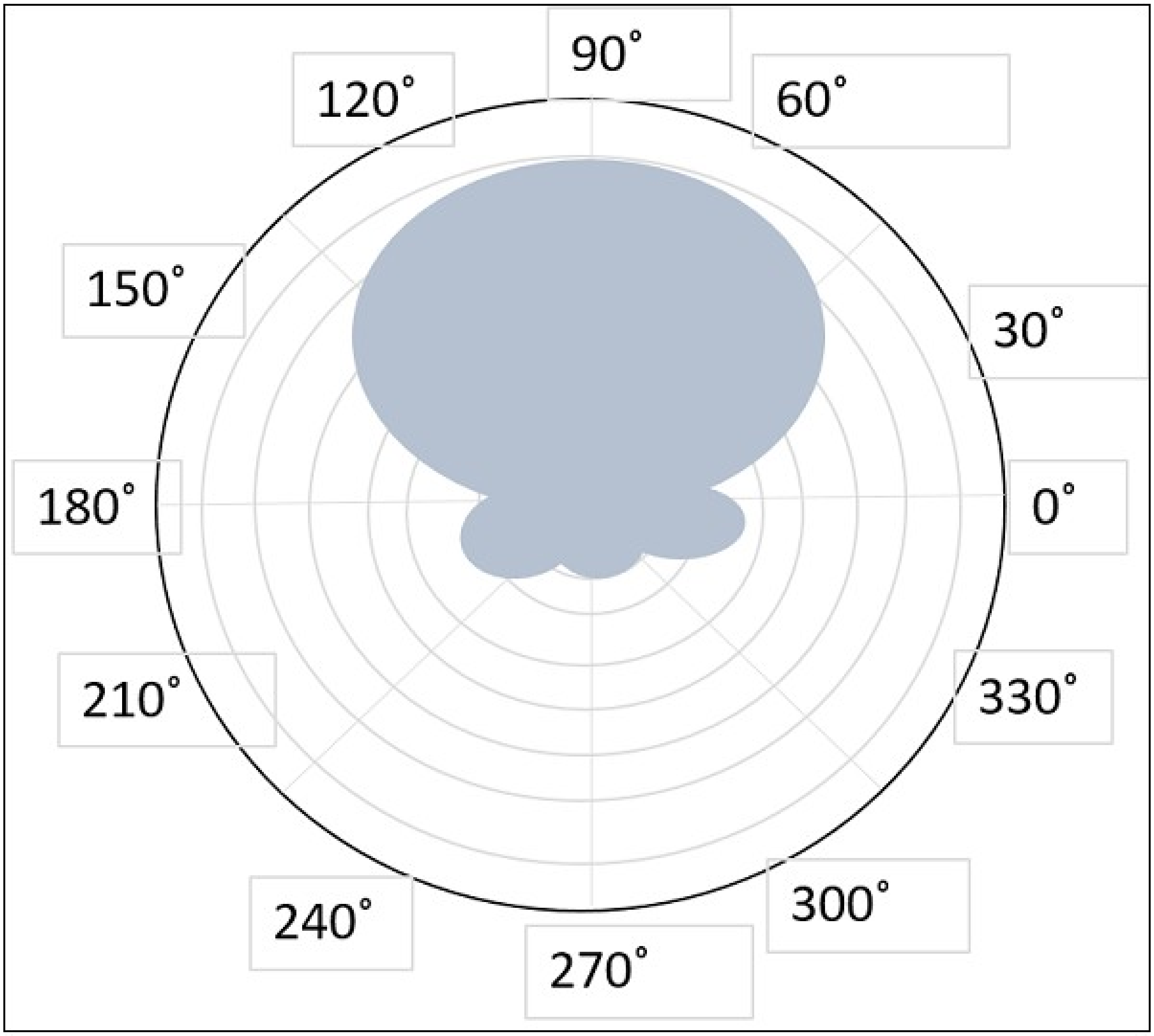
- τ is the design ratio and $\tau < 1$
- R is the distance between the feed and the dipole
- l is the length of the dipole.

The directive gains obtained are low to moderate. The radiational patterns may be **Unidirectional or Bi-directional**.

Radiation Pattern

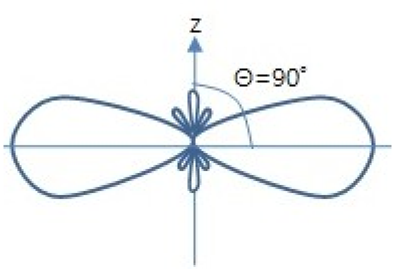
The Radiation pattern of log-periodic antenna can be of uni-directional or bi-directional, depending upon the log periodic structures.

For **uni-directional Log-periodic antenna**, the radiation towards shorter element is of considerable amount, whereas in forward direction, it is small or zero.



The radiational pattern for uni-directional log-periodic antenna is given above.

For **bi-directional Log-periodic antenna**, the maximum radiation is in broad side, which is normal to the surface of the antenna.



The figure given above shows the radiational pattern for a bi-directional log-periodic antenna.

Advantages

The following are the advantages of Log-periodic antennas −

- The antenna design is compact.
- Gain and radiation pattern are varied according to the requirements.

Disadvantages

The following are the disadvantages of Log-periodic antennas −

- External mount.
- Installation cost is high.

Applications

The following are the applications of Log-periodic antennas −

- Used for HF communications.
- Used for particular sort of TV receptions.
- Used for all round monitoring in higher frequency bands.
-

5)Explain in detail about microstrip patch antenna.

Micro strip antennas are low-profile antennas. A metal patch mounted at a ground level with a di-electric material in-between constitutes a **Micro strip** or **Patch Antenna**. These are very low size antennas having low rad

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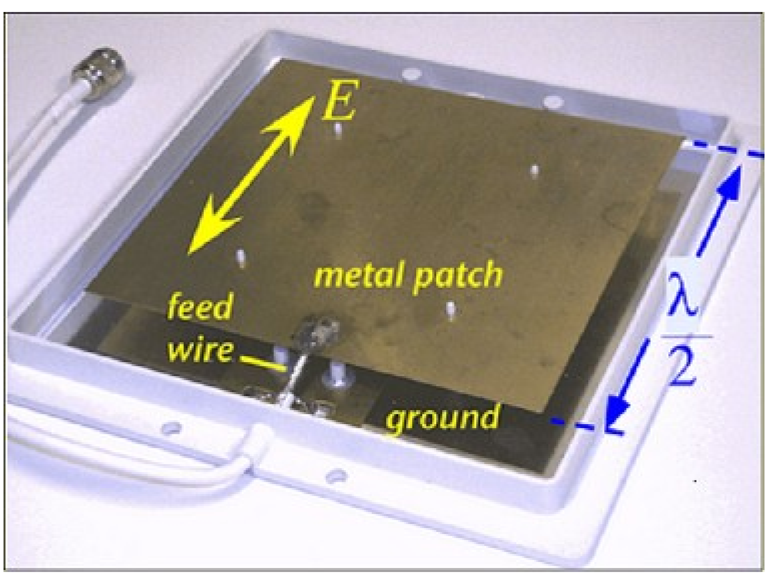
Frequency Range

The patch antennas are popular for low profile applications at frequencies above **100MHz**.

Construction & Working of Micro strip Antennas

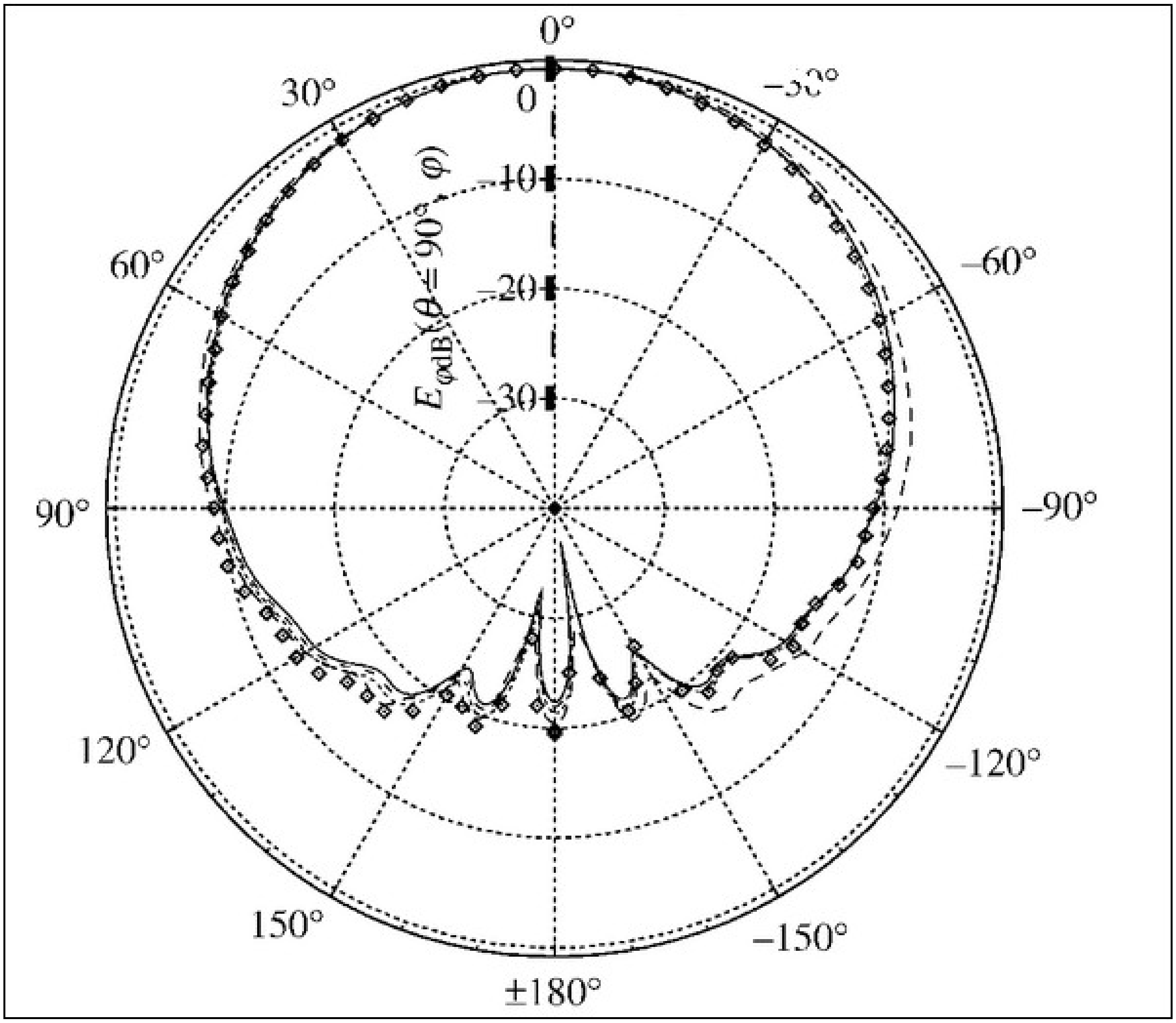
Micro strip antenna consists of a very thin metallic strip placed on a ground plane with a di-electric material in-between. The radiating element and feed lines are placed by the process of photo-etching on the di-electric material. Usually, the patch or micro-strip is choosen to be square, circular or rectangular in shape for the ease of analysis and fabrication. The following image shows a micro-strip or patch antenna.



The length of the metal patch is λ/2. When the antenna is excited, the waves generated within the dielectric undergo reflections and the energyis radiated from the edges of the metal patch,which is very low.

Radiation Pattern

The radiation pattern of microstrip or patch antenna is **broad**. It has low radiation power and narrow frequency bandwidth.



The **radiation pattern** of a microstrip or patch antenna is shown above. It has lesser directivity. To have a greater directivity, an array can be formed by using these patch antennas.

Advantages

The following are the advantages of Micro strip antenna −

- Lighteweight
- Low cost
- Ease of installation

Disadvantages

The following are the disadvantages of Micro strip antenna −

- Inefficient radiation
- Narrow frequency bandwidth

Applications

The following are the applications of Micro strip antenna −

- Used in Space craft applications
- Used in Air craft applications
- Used in Low profile antenna applications